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1. Assays of electronic piece parts for buried microbial contamination were continued using the biodetection grinder. The results of these assays are summarized in Table 1. In addition, 300 inches of 22 guage insulated wire used in spacecraft were assayed for microbial contamination. The exterior surface was sterilized, the insulation removed, and pools of five two-inch sections of wire and insulation were placed in separate tubes of TSB and incubated at 37 C. Only one tube containing insulation showed growth after two weeks of incubation, and no tubes with wire were positive.

   The effort to estimate the level of buried contamination in spacecraft components has become a cooperative project with Exotech, Incorporated. Accordingly, no attempt will be made to interpret the findings at this time. Rather, the data have been forwarded to Exotech and have been incorporated into their analytical approach to the problem.

   Studies were continued in an effort to better define the efficiency of the biodetection grinder in recovering buried microbial contamination. Experiments based on a paraffin model have been unsuccessful. Several new approaches based on the incorporation of Bacillus subtilis var. niger into wound coils of various plastic films are being investigated.

2. The heat resistance testing of the sieve-processed AO Hanger vacuum cleaner dust reported last quarter (Q.R. 34) was continued. Additional tests were performed according to the protocol described in Q.R. 34 except that incubation of the plates was extended to 14 days. Agar underlay and double overlay of the plates failed to reduce the amount of spreading growth sufficiently to allow incubation of the plates for 30 days. After 2 weeks at 32 C, the colonies of most plates were obscured by surface and/or subsurface growth. Figure 1 shows the results after sixteen 1/2" x 1/2" strips were heated at each interval. The D_{125C} value obtained from the best fit line of the mean values at each interval (98 min.) was comparable to the D_{125C} value of 94 min. as reported last quarter when only 4 strips were employed at each interval.

   A preliminary trial was conducted employing a larger amount of the 10% w/v AO Hangar dust in 95% ethanol. The equivalent of 0.1 gm of the dust (1 ml) was placed in each of 10 sterile, foil-capped, 125 ml Erlenmeyer flasks. The flasks were held under vacuum over silica gel for 16 hr., and eight were placed in a forced air oven at 125 C. At hourly intervals (plus 6 min. comeup time) two flasks were quickly removed from the oven and cooled in a horizontal laminar flow clean bench. Thermocouples inserted in control flasks showed only a slight temperature drop and rapid recovery during the opening and closing of the oven door to remove samples. Twenty ml of chilled 0.02% Tween 80 water were added to each flask, and each was insonated separately for 4 min. in an ultrasonic bath. Appropriate dilutions were plated in duplicate with TSA supplemented with 0.1% soluble starch and 0.2% yeast extract, overlayed, and plates were incubated for 2 weeks at 32 C. Figure 2 shows the results. The increased D-value of the population observed could be due

to a number of factors. The most probable explanation is that the D-value shown in Figure 1 was a necessarily weighted measure of the more heat sensitive spores in the population. When the N_0 was raised one log in Figure 2, the numbers of heat resistant spores were increased to a measurable range, and the total heating time of the experiment was increased. Other, but less likely explanations could be differences in heating systems or uneven distribution (layering) of spores and soil in the flasks. These possibilities will be investigated and reported later.

3. Heat resistance testing of Bacillus sp. 125-48 (Q.R. 33 & 34) was continued. In addition to the TAM and AK#2-grown spore suspensions reported last quarter, another suspension was prepared by harvesting 30-day growth (25 C) from six supplemented TSA (Q.R. 31) plates. The harvest was washed three times in cold buffered distilled water to remove the slime material and then washed three times with and finally resuspended in 95% ethanol. Heat testing was conducted as described last quarter. Figure 3 shows the results for the TSA-grown suspension. Four strips were heated at each interval on each of 3 days. As can be seen, the values for individual strips at each interval have wide ranges. This was due, in part, to incomplete removal and/or disruption of clumps of survivors from the stainless steel surfaces during the standard assay procedure. Even when insonation time was doubled (24 min.) in separate trials, some strips showed confluent growth on the inoculated surfaces when plated. Therefore, the D-value at 125 C of 28.4 hours as shown in Figure 3 is most likely a low estimate. Figure 4 shows the results when 12 strips inoculated with the AK suspension reported last quarter were heated at each interval. Likewise, the D-value of 59.5 hours is probably a low estimate of the actual resistance due to incomplete removal and/or dispersal of survivors from the strips. Additional assay methods will be tested to assure more accurate enumeration of survivors in future heat studies with this organism.

4. Microbiological studies were performed on the Apollo 15 spacecraft during assembly and testing at the Kennedy Space Center. Microbiological sampling of the interior surfaces of the Spacecraft Lunar Module Adapter (SLA) and exterior surfaces of the ascent and descent stages of Lunar Module 10 at the usual time of T-57 hours was not accomplished due to premature removal of the SLA 525 and 603 platforms. Alterations of normal time sequences and hold periods during this mission resulted in automatic platform removal when flight essential operations had been completed. Action has been taken to preclude such a reoccurrence on future missions.

   The levels of microbial contamination present on the Command Module (CM-112), Instrument Unit (IU), Saturn S-4B, and Spacecraft Lunar Module Adapter (SLA) are presented in Table 2. The contamination levels of the CM, IU, and S-4B were similar to those observed for the Apollo 14 (Q.R. 33). The interior surfaces of the SLA were found to have levels of microorganisms one log lower than those detected on the Apollo 14.

The quantitative data for the interior and exterior surfaces of the ascent and descent stages of the Lunar Module 10 (LM-10) and the first Lunar Roving Vehicle (LRV-1) are shown in Table 3. The levels of aerobic mesophilic microorganisms on the surfaces of the interior ascent stage (LAI), exterior ascent stage (LAE), and exterior descent stage (LDE) of the LM-10 were less than those detected on similar areas of the Lunar Module of Apollo 14. The microbial contamination (per sq. ft.) present on the surfaces of the LRV-1 was less than on the LDE to which it was attached.

The surfaces of the IU, S-4B and SLA showed a higher percentage of bacterial spores than on the CM surfaces (Table 4). With the exception of the SLA surfaces, the percentage of molds also was higher. Molds have not been isolated from the SLA surfaces of the last four Apollo spacecraft. Higher percentages of bacterial spores were found on the surfaces of the LAE than on the LDE (Table 5).

The surfaces of the LAE revealed a higher percentage of bacterial spores and molds than on the surface of the LAE of Apollo 14. Although the levels of aerobic mesophilic microorganisms detected on the exterior surfaces of the LRV-1 were lower than those found on the LAI, LAE, and LDE, the percentage of bacterial spores was higher on the surface of the LRV-1 than on the LAI and LDE. The LRV-1 also contained a higher percentage of molds than detected on the surfaces of the LAI, LAE, and LDE.

Table 6 shows a comparison of the levels of microbial contamination detected on the Apollo 10, 11, 12, 13, 14, and 15 spacecraft. The levels of the aerobic mesophilic microorganisms per square foot of surface for each of the four component parts were relatively consistant from Apollo 10 to 15. The percentage of aerobic spores found on Apollo 15 was slightly higher than observed for Apollo 14.

A comparison of the levels of microbial contamination of the Lunar Modules is presented in Table 7. Lower numbers of microorganisms (ca. 1 log per square foot) were found on the LAI, LAE, and LDE of Apollo 15 than on Apollo 14. Although the levels of aerobic mesophiles on the LAI and LAE were similar to previous Lunar Modules, the percentage of aerobic spores for these components were greater than the LAI and LAE of all earlier Lunar Modules. The percentages of aerobic spores and molds detected on the LRV-1 were greater than all previous LM component parts with the exception of the spore concentration of the LAE of Apollo 15.

The Apollo 15 mission presented the first opportunity to take post-flight microbiological samples on the interior surfaces of the Command Module. This was made possible by the elimination of the 21 day back-contamination quarantine period. In addition to the F-14 day, F-7 day, and T-24 hour sampling of the CM, a T-9 hour (pre-flight) sample was taken by a member of the astronaut back up crew. The post-flight microbiological samples were taken on board the recovery vessel as soon as possible by the Flight Surgeon. Samples were taken from the same locations as for

pre-flight, kept at 4 C, transported to the Spacecraft Bioassay Laboratory at Cape Kennedy, and were assayed within 30 hours after being taken. Table 8 shows the results of the pre and post-flight microbiological sampling. For purposes of comparison, the fifteen sampling sites in the Command Module were divided into three groups, and the mean number of microorganisms per square inch is recorded for each group. Comparison of the pre and post-flight microbiological results of the individual surface sites sampled are shown in Table 9. The levels of microorganisms increased in some areas by 3 logs per square inch. These increases might have been greater if the samples could have been assayed immediately after haven been taken. The zero microbial count at T-9 hours for the Drink Gun is not surprising since the gun was sterilized prior to being installed in the CM.

A total of 1,172 microorganisms were isolated from the Apollo 15 spacecraft. In addition, 183 and 327 bacterial isolates were obtained from the interior surfaces of the Command Module at pre-flight (T-9 hours) and post-flight sampling periods, respectively. These isolates are being identified and results will be reported during the next quarter.

The study for the evaluation of a terminal sterilization process for unmanned lander spacecraft is continuing. Results will be reported during the next quarter.

5. A study was initiated to determine the thermal resistance of naturally occurring airborne spores. Fallout contamination in the Low Bay area of the MSOB will be allowed to accumulate on specialized teflon fallout strips intended to simulate spacecraft surfaces and will subsequently be exposed to dry heat at 125 C.

   During assembly and test of the Mariner-Mars 1971 spacecraft, investigators from the Jet Propulsion Laboratory conducted a series of tests in which ribbons of teflon (3" x 72") were exposed to fallout contamination for 1 week in various assembly areas. The ribbons were then rolled up, inserted in jars, and placed in an oven at 125 C for time intervals ranging from 1-13 hours. After heating, the ribbons were assayed for surviving microorganisms. The D_{125C} values, which were calculated by the method of Pflug (fractional-negative - MPN), ranged from .4 to 2.2 hours depending on the length of exposure to heat. The current study will be designed as a logical extension of the JPL work.

6. A study was begun to determine the effect of surfaces angles on the collection of viable airborne fallout on stainless steel strips. Stainless steel strips were cleaned according to NASA Standard Procedures, placed on modified aluminum trays, covered with aluminum foil and sterilized in a dry heat oven at 175 C for 3 hours. The trays, each containing 48 strips, were placed on the exposure platforms located in the Manned Spacecraft Operations Building clean rooms and the aluminum foil covering removed. The surface angles employed in this study were 0^{o}, 30^{o}, 60^{o}, and 90^{o} from the horizontal. After one week of exposure, six strips were randomly retrieved from each tray on Monday,

Tuesday, and Wednesday of each week until all strips were collected. Each strip was placed into a sterile 250 ml Erlenmeyer flask, returned to the laboratory, and 50 ml of sterile buffered Tween solution (NASA Standard Procedures) was added to each flask. The flasks were insonated for 2 minutes and the entire 50 ml of solution was poured into 150 x 15 mm petri plates. Fifty ml of sterile, molten, double strength Trypticase Soy Agar (TSA) was added to each plate, mixed and allowed to solidify. Plates were incubated at 35 C and plate counts were performed at 48 and 72 hours.

Four trays of 48 strips were exposed at each of the four angles. The results of the assays of these strips were statistically analyzed, and it was determined that the values from four trays at each angle could validly be pooled for further analyses. The data is presented in Table 10. The mean and median values observed at each angle were analyzed using a chi-square-goodness-of-fit test for several theoretical relationships. It was found that both the mean and median levels of contamination at each angle were proportional to the projected horizontal area of the strip at that angle. The goodness-of-fit was better for the median values than for the mean values. This suggests that, in general, the levels on surfaces inclined 30^{o} and 60^{o} from the horizontal would be 87 percent and 50 percent, respectively, of the level on a horizontal surface. Because some microorganisms were observed on vertical surfaces a correction factor for these observed levels was applied. Further studies are planned to determine the levels of microorganisms on inverted surfaces at different angles.

TABLE 1. RESULTS OF BIODETECTION GRINDER ASSAYS OF ELECTRONIC PIECE PARTS.

Piece Parts	Units Sampled	Units Positive	Total Volume Sampled cm^3	Total Colonies	Mean Microbial Concentration Colonies/cm^3
Carbon Core Resistor	6	0	3.0×10^{0}	0	0
Small Carbon Core Resistor	6	2	1.2×10^{0}	10	8.3
Semi Conductor Rectifier	6	4	1.1×10^{1}	9	0.8
Large Mylar Capacitor	8	2	1.3×10^{1}	3	0.2
Small Mylar Capacitor	2	0	1.4×10^{-1}	0	0
Large Metal Film Resistor	5	3	1.7×10^{0}	5	2.9
Small Metal Film Resistor	3	1	3.8×10^{-1}	1	2.6
Short Resistor	8	1	1.5×10^{0}	1	0.7
Coil Core	3	2	1.4×10^{1}	3	0.2
Large Wire Wound Resistor	1	1	1.1×10^{0}	3	2.7
Small Wire Wound Resistor	2	1	4.8×10^{-1}	1	2.1

TABLE 2. LEVELS OF MICROBIAL CONTAMINATION DETECTED ON THE APOLLO 15 COMMAND MODULE (CM-112), INSTRUMENT UNIT (IU), SATURN S-4B (S-4B), AND THE SPACECRAFT LUNAR MODULE ADAPTER (SLA).

Source[1]	Date Sampled	Area Sampled[2] (sq.in.)	No. Microorganisms per Square Foot			
			Aerobes	Anaerobes	Aerobic Spores	Anaerobic Spores
CM-112	6-15-71	60	1.0×10^5	2.6×10^4	3.7×10^2	3.6×10^1
	7-15-71	60	7.4×10^4	3.2×10^4	2.9×10^2	3.6×10^1
	7-19-71	60	1.7×10^4	7.1×10^3	3.1×10^2	9.0×10^1
	7-25-71	60	4.9×10^4	-	2.4×10^1	0
IU	7-15-71	60	3.3×10^4	7.0×10^3	1.0×10^3	2.0×10^2
	7-19-71	60	1.7×10^4	9.4×10^2	1.5×10^3	4.0×10^2
	7-23-71	60	3.4×10^4	2.6×10^3	1.5×10^3	4.0×10^2
S-4B	7-15-71	60	3.5×10^4	7.2×10^3	1.9×10^3	4.2×10^2
	7-19-71	60	3.7×10^4	1.2×10^4	2.4×10^3	4.4×10^2
	7-23-71	60	8.4×10^4	1.0×10^4	2.0×10^3	2.9×10^2
SLA	7-15-71	60	1.2×10^1	1.2×10^1	1.2×10^1	0
	7-19-71	60	7.2×10^1	0	1.2×10^1	0

[1] Samples were taken from the interior surfaces of the spacecraft located at Launch Complex 39 A.
[2] Swab-rinse technique.

TABLE 3. LEVELS OF MICROBIAL CONTAMINATION DETECTED ON LUNAR MODULE 10 (APOLLO 15), AND LUNAR ROVING VEHICLE 1 (LRV-1).

Source	Date Sampled[2]	Area Sampled[1] (sq.in.)	No. Microorganisms per Square Foot			
			Aerobes	Anaerobes	Aerobic Spores	Anaerobic Spores
Ascent Stage (interior)	6-15-71	60	4.6×10^5	2.9×10^5	6.5×10^2	1.4×10^2
	7-15-71	60	3.4×10^4	8.4×10^3	8.5×10^2	2.2×10^2
	7-19-71	60	4.6×10^4	3.0×10^4	4.6×10^2	2.2×10^2
	7-23-71	60	2.1×10^4	5.5×10^3	5.0×10^2	1.9×10^2
Ascent Stage (exterior)	6-15-71	60	4.0×10^4	1.6×10^4	8.6×10^2	1.6×10^2
	7-15-71	60	1.3×10^4	2.3×10^3	4.9×10^2	2.4×10^1
	7-19-71	60	3.3×10^3	1.0×10^3	8.4×10^2	1.4×10^2
Descent Stage (exterior)	6-15-71	60	8.7×10^4	3.6×10^4	4.1×10^2	3.6×10^1
	7-15-71	60	3.8×10^4	1.8×10^4	6.0×10^2	2.4×10^2
	7-19-71	60	3.4×10^3	2.2×10^2	6.0×10^1	1.2×10^1
LRV (exterior)	7-15-71	60	2.1×10^3	9.5×10^2	1.3×10^2	4.8×10^1
	7-19-71	60	3.2×10^2	1.2×10^1	4.8×10^1	2.4×10^1
	7-23-71	60	1.9×10^3	3.1×10^2	9.6×10^1	2.4×10^1

[1] Swab-rinse technique.

[2] Samples were taken while modules were located at Launch Complex 39 A.

TABLE 4. COMPARATIVE LEVELS OF AEROBIC BACTERIAL SPORES AND MOLDS DETECTED ON THE APOLLO 15 COMMAND MODULE (CM-112), INSTRUMENT UNIT (IU), SATURN S-4B, AND ON THE SPACECRAFT LUNAR MODULE ADAPTER (SLA).

Source	Date Sampled[3]	Area Sampled[1] (sq.in.)	Percent[2]	
			Aerobic Bacterial Spores	Molds
Command Module CM-112	6-15-71	60	0.37	0.00
	7-15-71	60	0.39	0.03
	7-19-71	60	1.20	0.14
	7-25-71	60	0.05	0.00
Instrument Unit	7-15-71	60	3.13	1.31
	7-19-71	60	9.16	3.62
	7-23-71	60	4.49	1.32
SLA	7-15-71	60	100.00	0.00
	7-19-71	60	16.67	0.00
S-4B	7-15-71	60	5.30	3.02
	7-19-71	60	6.55	1.39
	7-23-71	60	2.37	0.57

[1] Swab-rinse technique.
[2] Percentage of toal aerobic mesophilic microorganisms
[3] Samples were taken while spacecraft was located at Launch Complex 39 A.

TABLE 5. COMPARATIVE LEVELS OF AEROBIC BACTERIAL SPORES AND MOLDS DETECTED ON SURFACES OF THE ASCENT AND DESCENT STAGES OF LUNAR MODULE AND LUNAR ROVING VEHICLE 1 (LRV-1).

Source[3]	Date Sampled	Area Sampled[1] (sq.in)	Percent[2]	
			Aerobic Bacterial Spores	Molds
Ascent Stage (interior)	6-15-71	60	0.14	0.005
	7-15-71	60	2.50	0.14
	7-19-71	60	0.99	0.26
	7-23-71	60	2.42	0.0
Ascent Stage (exterior)	6-15-71	60	2.16	0.11
	7-15-71	60	3.86	0.13
	7-19-71	60	25.27	0.36
Descent Stage (exterior)	6-15-71	60	0.47	0.13
	7-15-71	60	1.57	0.22
	7-19-71	60	1.76	1.76
LRV-1 (exterior)	7-15-71	60	6.18	1.69
	7-19-71	60	14.81	22.22
	7-23-71	60	5.16	2.58

[1] Swab-rinse technique.
[2] Percentage of total aerobic mesophilic microorganisms.
[3] Samples were taken while modules were at Launch Complex 39 A.

TABLE 6. COMPARISON OF THE LEVELS OF MICROBIAL CONTAMINATION DETECTED ON COMPONENTS OF THE APOLLO 10, 11, 12, 13, 14, AND 15 SPACECRAFT.

Source	No. Microorganisms per Square Foot[1]				Percent[2]	
	Aerobes	Anaerobes	Aerobic Spores	Anaerobic Spores	Aerobic Spores	Molds
Command Module						
Apollo 10	2.1×10^4	1.3×10^4	1.7×10^2	2.1×10^1	0.80	0.02
Apollo 11	2.7×10^4	1.6×10^4	1.3×10^2	8.8×10^1	0.46	0.07
Apollo 12	2.9×10^4	1.4×10^4	4.0×10^1	2.4×10^1	0.14	0.0
Apollo 13	4.1×10^4	1.8×10^4	5.2×10^1	1.2×10^1	0.13	0.02
Apollo 14	7.1×10^4	2.8×10^4	1.7×10^2	6.0×10^1	0.24	0.005
Apollo 15	4.7×10^4	2.0×10^4	2.1×10^2	4.2×10^1	0.37	0.03
Instrument Unit						
Apollo 10	1.5×10^4	2.7×10^3	1.9×10^3	2.7×10^2	12.94	3.95
Apollo 11	7.6×10^3	3.7×10^3	1.3×10^4	1.6×10^2	17.33	7.79
Apollo 12	2.0×10^4	4.6×10^3	6.3×10^2	2.6×10^2	3.16	0.84
Apollo 13	1.0×10^4	1.7×10^3	5.4×10^2	1.4×10^2	5.46	2.05
Apollo 14	3.1×10^4	8.5×10^3	1.2×10^3	2.5×10^2	3.73	2.19
Apollo 15	2.8×10^4	3.5×10^3	1.4×10^3	3.3×10^2	4.89	1.78
S-4B						
Apollo 10	2.1×10^4	3.3×10^3	3.1×10^3	3.2×10^2	14.66	1.97
Apollo 11[3]	9.6×10^3	3.0×10^3	1.9×10^3	4.4×10^2	19.59	4.86
Apollo 12	3.0×10^4	4.1×10^3	1.1×10^3	1.9×10^2	3.69	0.20
Apollo 13	1.3×10^4	2.1×10^3	1.0×10^3	2.0×10^2	7.92	1.02
Apollo 14	4.8×10^4	8.6×10^3	1.7×10^3	3.8×10^2	3.63	1.41
Apollo 15	5.2×10^4	9.7×10^3	2.1×10^3	3.8×10^2	4.02	1.32

TABLE 6. COMPARISON OF THE LEVELS OF MICROBIAL CONTAMINATION DETECTED ON COMPONENTS OF THE APOLLO 10, 11, 12, 13, 14, AND 15 SPACECRAFT. (Continued)

Source	No. Microorganisms per Square Foot[1]				Percent[2]	
	Aerobes	Anaerobes	Aerobic Spores	Anaerobic Spores	Aerobic Spores	Molds
SLA						
Apollo 10	2.2×10^2	2.4×10^1	1.2×10^1	1.6×10^1	5.58	1.86
Apollo 11	8.3×10^1	2.4×10^1	6.5×10^1	2.4×10^1	78.31	4.82
Apollo 12	2.8×10^1	1.6×10^1	1.6×10^1	3.2×10^1	57.10	0.00
Apollo 13	1.6×10^1	8.0×10^0	4.0×10^0	0.0	25.00	0.00
Apollo 14	1.8×10^2	5.6×10^1	2.0×10^1	0.0	10.90	0.00
Apollo 15[4]	4.2×10^1	6.0×10^0	1.2×10^1	0.0	28.57	0.00

[1] Average of three final sampling periods. Total area sampled was 180 sq. in.

[2] Percentage of total aerobic mesophilic microorganisms.

[3] Total area samples was 160 sq. in.

[4] Average of F-14 and F-7 day sampling periods. Total area samples was 120 sq. in.

TABLE 7. COMPARISON OF THE LEVELS OF MICROBIAL CONTAMINATION DETECTED ON THE LUNAR MODULES OF APOLLO 10, 11, 12, 13, 14, AND 15 SPACECRAFT, AND LUNAR ROVING VEHICLE 1 (LRV-1).

Source	No. Microorganisms per Square Foot[1]				Percent[2]	
	Aerobes	Anaerobes	Aerobic Spores	Anaerobic Spores	Aerobic Spores	Molds
Ascent Stage (interior)						
Apollo 10	1.8×10^5	1.0×10^5	3.7×10^2	3.2×10^1	0.21	0.002
Apollo 11	8.2×10^4	3.1×10^4	3.3×10^2	6.4×10^1	0.41	0.03
Apollo 12	4.9×10^4	1.3×10^4	7.2×10^1	2.4×10^1	0.15	0.16
Apollo 13	3.7×10^4	9.0×10^3	7.6×10^1	3.6×10^1	0.20	0.02
Apollo 14	1.1×10^5	5.5×10^4	3.1×10^2	6.0×10^1	0.29	0.02
Apollo 15	3.4×10^4	1.5×10^4	6.0×10^2	2.1×10^2	1.79	0.17
Ascent Stage (exterior)						
Apollo 10	5.0×10^3	1.1×10^3	1.5×10^2	2.0×10^1	3.10	0.32
Apollo 11	5.1×10^3	1.2×10^3	1.8×10^2	3.6×10^1	3.50	2.68
Apollo 12	2.0×10^3	7.2×10^2	5.6×10^1	2.4×10^1	2.75	0.39
Apollo 13	2.7×10^3	6.1×10^2	3.6×10^1	1.2×10^1	1.33	0.74
Apollo 14	2.1×10^4	3.3×10^3	1.8×10^2	4.0×10^1	0.88	0.34
Apollo 15[4]	8.0×10^3	1.7×10^3	6.7×10^2	8.4×10^1	8.29	0.97
Descent Stage (exterior)						
Apollo 10[3]	1.6×10^4	1.1×10^4	5.1×10^2	5.4×10^1	3.13	1.08
Apollo 11	4.6×10^3	1.1×10^3	2.6×10^2	2.4×10^1	5.69	1.14
Apollo 12	1.1×10^4	5.2×10^3	1.4×10^2	2.8×10^1	1.25	0.44
Apollo 13	3.4×10^4	2.5×10^4	6.8×10^1	1.2×10^1	0.20	0.08
Apollo 14	1.1×10^5	6.0×10^4	2.3×10^2	4.0×10^1	0.21	0.04
Apollo 15[4]	2.1×10^4	9.2×10^3	3.3×10^2	1.3×10^2	1.58	0.35
Lunar Roving Vehicle						
Apollo 15	1.4×10^3	4.2×10^2	9.2×10^1	3.2×10^1	6.39	3.61

[1] Average of three final sampling periods. Total area sampled was 180 sq. in.
[2] Percentage of total aerobic mesophilic microorganisms.
[3] Total surface area sampled was 140 sq. in.
[4] Average of F-14 and F-7 day sampling periods. Total area sampled was 120 sq. in.

TABLE 8. RESULTS OF PRE AND POST-FLIGHT MICROBIOLOGICAL SAMPLING OF SURFACES IN APOLLO 15 COMMAND MODULE.

Pool	Areas Sampled	Mean No. Microorganisms Per Square Inch		
		T-24 Hrs.	[1] T-9 Hrs.	[2] Post-Flight
1	Girth Shelf - Right Girth Shelf - Left Waste Disposal Rim (Compartment No. 5) Top Flight Recorder (Flight Tape Recorder) Reaction Jet Control (On-Off)	9.4×10^1	9.3×10^1	3.8×10^3
2	Exposed Floor by Hatch Ordeal Cable Stowage (Top) Vertical Couch Support Beam - Right Vertical Couch Support Beam - Left Horizontal Couch Support Beam - Right	8.7×10^2	1.1×10^2	5.3×10^3
3	Horizontal Couch Support Beam - Center Horizontal Couch Support Beam - Left Ledge Below Left Window Right Control Handle (RHC) Left Control Handle (RHC)	6.4×10^1	4.4×10^1	8.7×10^3
	Drink Gun	-	0	5.2×10^3

[1] No sample taken from horizontal couch support beam center.

[2] No sample taken from horizontal couch support beam center or horizontal couch support beam left.

TABLE 9. COMPARISON OF THE PRE AND POST FLIGHT MICROBIOLOGICAL RESULTS OF THE INDIVIDUAL SURFACE SITES SAMPLED IN APOLLO 15 COMMAND MODULE.

Areas Sampled	Mean No. Microorganisms Per Square Inch	
	T-9 Hrs.	Post-Flight
Girth Shelf - Right	7.5×10^1	4.5×10^1
Girth Shelf - Left	1.3×10^2	1.9×10^3
Waste Disposal Rim (Compartment No. 5)	8.8×10^1	1.7×10^4
Top Flight Recorder (Flight Tape Recorder)	1.3×10^2	5.0×10^0
Reaction Jet Control (On-Off)	5.0×10^1	6.0×10^1
Exposed Floor by Hatch	1.5×10^2	TNTC[1]
Ordeal Cable Stowage (Top)	5.8×10^1	2.1×10^4
Vertical Couch Support Beam - Right	2.5×10^0	9.8×10^1
Vertical Couch Support Beam - Left	0.0	1.8×10^2
Horizontal Couch Support Beam - Right	3.3×10^2	2.0×10^2
Horizontal Couch Support Beam - Left	1.5×10^2	Sample Not Taken
Ledge Below Left Window	2.3×10^1	2.6×10^4
Right Control Handle (RHC)	0.0	2.9×10^2
Left Control Handle (LHC)	0.0	4.0×10^1
Drink Gun[2]	0.0	5.2×10^3

[1] TNTC - Too Numerous to Count

[2] Total number of microorganisms recovered from sample.

TABLE 10. LEVELS OF MICROORGANISMS OBSERVED ON SS FALLOUT STRIPS INCLINED AT 0°, 30°, 60°, AND 90° TO THE HORIZONTAL.

Angle of Inclination to Horizontal	Total No. Microorganisms Per Strip	
	Mean	Median
0°	99	42
30°	89	33
60°	36	17
90°	9	3

FIGURE 1. AO HANGAR VACUUM CLEANER DUST; SIEVE PROCESSED DRY; 0.01 g/STRIP IN 95% ETHANOL.

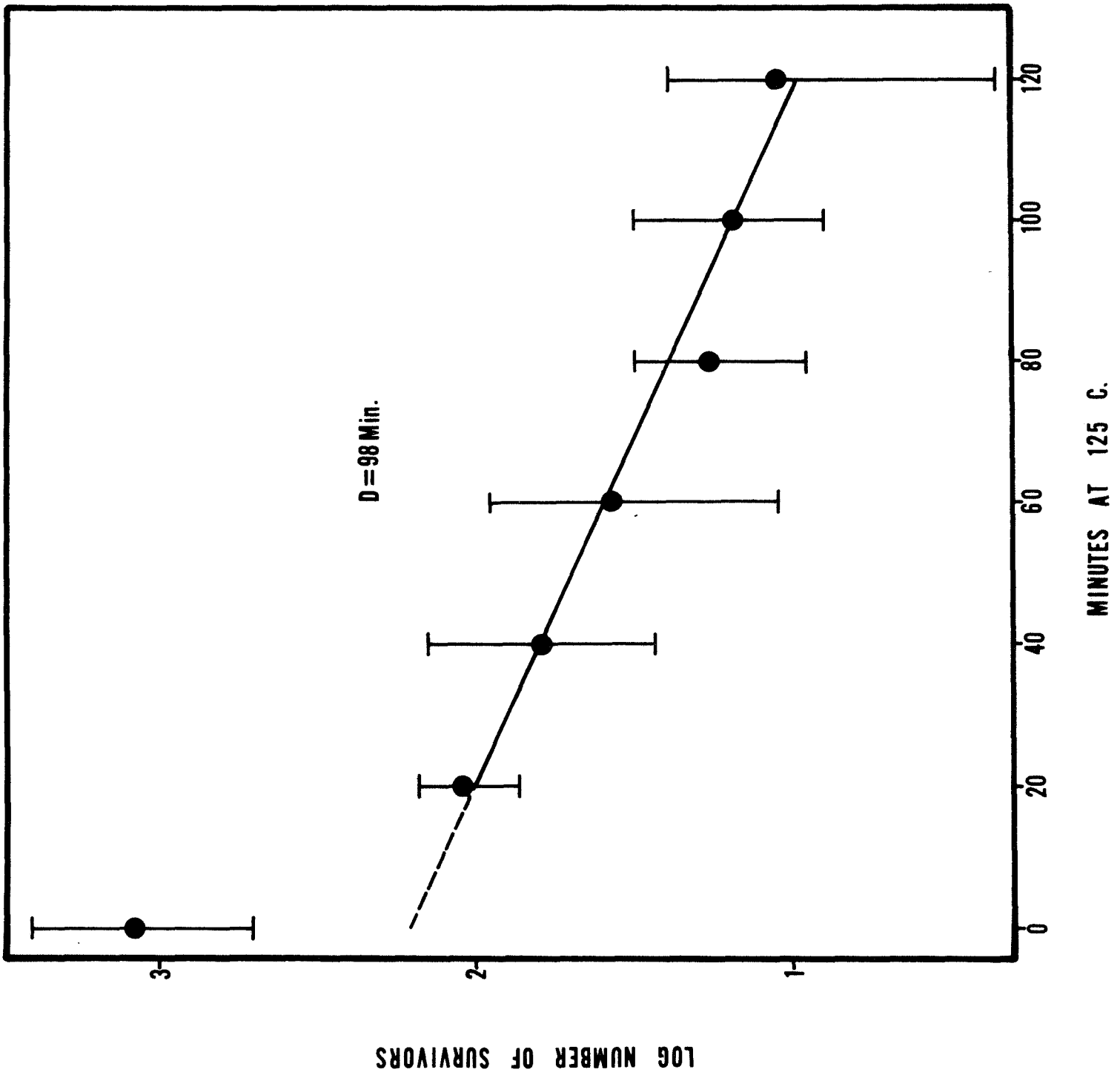

FIGURE 2. AO HANGAR VACUUM CLEANER DUST; SIEVE PROCESSED DRY; 0.1 g/FLASK IN 95% ETHANOL.

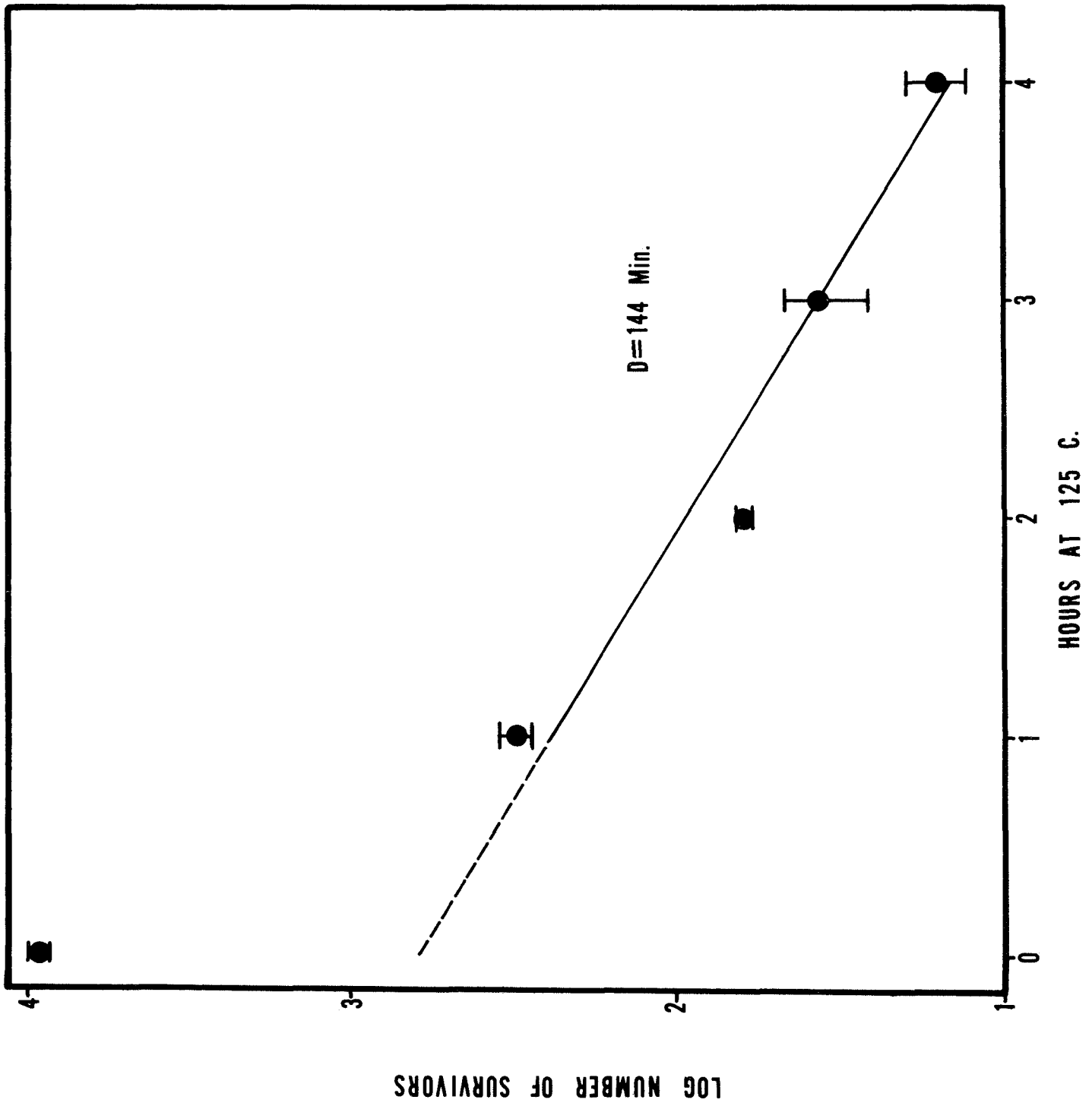

FIGURE 3. BACILLUS, SP. 125-48, TSA + SPORES IN 95% ETHANOL.

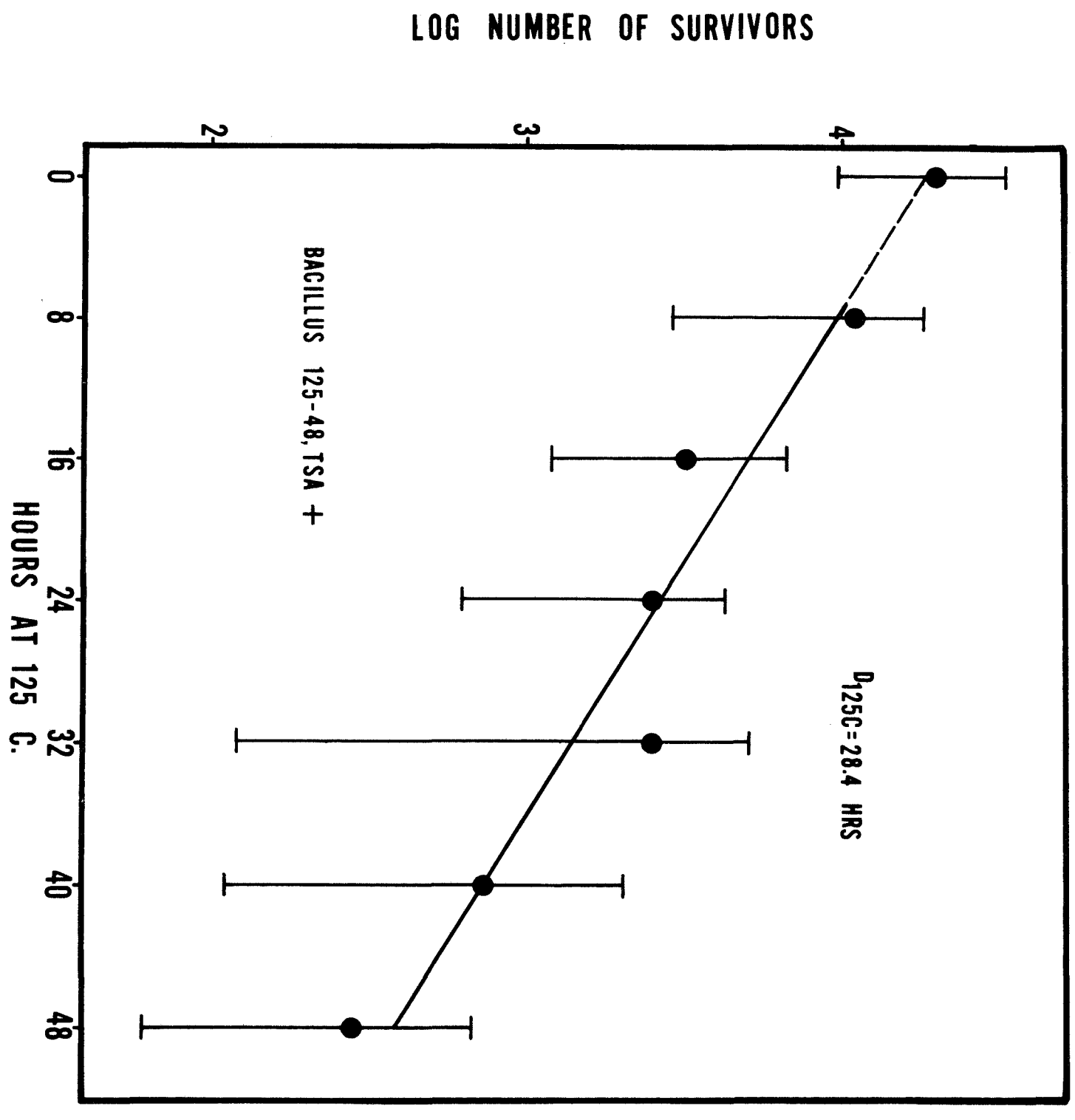

FIGURE 4. BACILLUS, SP. 125-48, AK#2 SPORES IN DISTILLED WATER.